After a time they die. Their ill-health under these circumstances is apparently due not merely to the want of food, since with sufficient trouble the small Entomostraca on which they feed can be supplied to them, but to the very fact of isolation in a small receptacle. They require a large bulk of water. Fluviatile organisms can be kept in a small vessel by means of a constant stream passed through the vessel, and organisms which inhabit small ponds present no difficulty. But lacustrine forms are very difficult to deal with. Should the Medusæ reappear this year, it is my intention (with the permission of the authorities) to partially submerge a vessel with freely perforated sides in the large tank, the bottom of such vessel to be imperforate, and the vessel itself two feet in diameter and three feet in depth. If a sufficient number of the first brood of young Medusæ can be cultivated in this vessel through the summer, both males and females (unless the females have some altogether unsuspected history) will in all probability arrive at maturity, and reproduce in it as they clearly enough have done in the Regent's Park tank between 1880 and 1881. It will then be possible from time to time to examine carefully the contents of this experimental vessel. I need not say that I should be very glad if others would carry out a similar experiment.

E. RAY LANKESTER

ELECTRICITY AT THE CRYSTAL PALACE

II.—*Edison's Electric Light*

THE centre of attraction at the exhibition of electricity in the Crystal Palace, formally opened on Saturday by the Duke and Duchess of Edinburgh, will unquestionably be the show of Mr. Edison. His electric light in the Entertainment Court and the Concert Room is by far the finest ever yet made, and is of itself a spectacle to be remembered. No expense has been spared to demonstrate the power and beauty of his incandescent lamps, and the divisibility of the current to meet the wants of domestic lighting; while Messrs. Verity and Sons have seized the occasion to illustrate their skill and show how eminently adapted the electric light is for ornamental purposes. The heated filament of carbon inclosed in a vacuous bulb of glass is well fitted for all kinds of domestic illumination by reason of its pure and absolutely steady glow, its healthiness and freedom from noxious fumes, and its comparative coolness. But in addition to its superiority over gas, oil, and candles in these respects, the Edison exhibit also proves in the most striking manner its superiority as a decorative light, and its unrivalled capacities for enhancing the artistic pleasures of our homes. Besides giving off no deleterious gases to tarnish gilding or dim the most delicate colours, the incandescent lamp lends itself to the designer's fancies in a way which no other illuminant can; and we may expect something like a revolution in household decoration by its introduction, as well as a new development of the brass-worker and the glass-blower's art.

Before considering the apparatus employed by Mr. Edison at the Crystal Palace for the production and distribution of the light, we shall briefly describe the results. To begin with the Entertainment Court, which is in reality a small theatre, the principal object of interest is a magnificent chandelier suspended from the middle of the ceiling. This beautiful object is in itself a work of art, and sustains ninety-nine incandescent lamps. It is conical in general shape, and is about fifteen feet in height by ten feet in diameter at the lower end; while its weight is half a ton. In device it represents a tapering bouquet of flowers rising out of a golden basket. The stem of each flower springs from a circular brass plate within the basket, and bends over towards the spectator, presenting to him its calyx of coloured glass, in which is fixed an incandescent lamp. The foliage is all of hammered brass, richly gilt, and here and there is mingled with the sun-flower or tiger-lily, and some rambling sprays of fern. The corollas of the flowers containing the lamps, and acting as their shades, are in the form of heaths and harebells, made of glass, and tinted with a variety of colours—pearl, white, ruby, clear olive, and clouded blue. Each lamp projects from the heart of the flower like an enlarged pistil, and throws its light outwards and downwards into the room below. The lights are controlled in three sections by turncocks, like gas, and thus a graduated effect can be obtained, or all the lights may be put on or off at will.

On each side of the stage, which is furnished with a row of twenty-four footlights, there is a pretty candelabra [1] mounted on a short marble column, and representing a rose-bush springing from a golden urn. The stem of the bush is entwined with China roses, and crowned with five upright lamps or candles, like the fruit of the tree. On the left of the stage is hung an exquisite little chandelier or lustre of Venetian glass, which, though far less imposing than its gaudier neighbour in the centre of the hall, is chaster and more elegant, and better fitted for an ordinary drawing-room. It is about four feet high, and consists of loops and festoons of crystal drops on gilded chains, encircled at the bottom by a ring of fourteen lamps; and inclosing higher up a single incandescent bulb of ruby glass under a bell shade of the same material. The use of coloured glass for the vacuous bulb itself is illustrated here, and shows how the light can be tinted to harmonise with any interior furnishing, or suit the taste and eyesight of individuals. The brilliance of the glowing carbon in a transparent bulb is not too strong for the ordinary eye to look at with impunity; but persons of weak sight may have it reduced by the use of clouded bulbs, and students, or those suffering from diseases of the eye can employ bulbs of green or blue glass. Photographers, too, can have recourse to ruby lamps in the development of their negatives.

On the right side of the stage there is a third chandelier of gilt brass, with twelve naked bulbs, a number of single lamps on stands or movable brackets, like gas-jets, with turn-cocks, and either naked or shaded by flat conical reflectors of opal glass. Specimens of these are shown in Figs. 1 and 2. Then there are hall-lanterns of brass, inclosing clusters of bulbs, window-lights, a very handsome billiard lamp, containing six set of twin lamps, shaded from the eyes of the players by opal glass reflectors and crimson fringes, and two handsome drawing-room shade-lamps of the same pattern, each containing a cluster of eight bulbs inside, and one being supplemented by four pairs of naked bulbs outside. Bulbs are also shown burning under water, either clear or tinted, to illustrate the use of the incandescent system in fiery mines, and there is a specimen of a regulator lamp by which the power of the jet can be graduated at will like a gas-flame, by simply turning the cock. This lamp is shown in Fig. 3, the lower being the regulator, which acts by inserting the resistance of a series of vertical carbon rods into the circuit. This is done by turning the screw-piece at the base of the cylinder inclosing the bars. The cylinder is perforated to allow the air to circulate and keep them cool.

In the top of the lamp the novelty is the form of the contact surfaces to prevent sparking or breaking the circuit. These are conical, the small cone seen on the top of the figure being forced away from a conical cup on turning the screw plug. The large surfaces of the cones prevent simultaneously separating, and prevent a large spark. A safe-guard for the lamp against a too powerful current is provided in a short lead wire, seen running across the left of the figure. When the current is too strong this wire fuses, and the current of the lamp is interrupted.

[1] Electrolier and electrolabra would be the corresponding terms.

In addition to these lamps Mr. Edison also exhibits some very handsome sconce mirrors supplied by Messrs. Verity and Sons. One of these is a novelty in its way, since the bulb lighting it is inside the frame, and therefore out of sight. The interior of the frame is, however, whitened, and reflects the light out through narrow panes of clouded glass which flank the central mirror, and the face of the spectator thus illuminated can be seen in the

mirror. This is another effect which could not be produced by gas. The other sconces are lit by naked bulbs, supported by in front of the mirrors, curving brass brackets in which the ruling idea of foliage and flower or fruit is elegantly worked out.

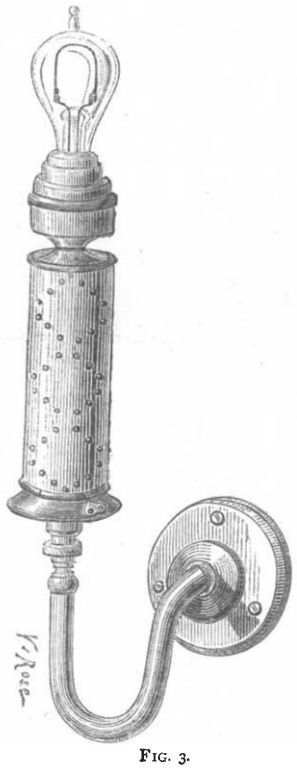

FIG. 3.

In the Concert Room, opposite the Entertainment Court, there are some 280 lamps, about forty of which are termed "half-lights," that is, giving 8 candle-power, or a light one-half of the full 16 candle-lights. Of these 120 are hung in festoons between the pillars of the galleries, the rest being suspended in sets of four under the galleries, or fixed within a large crystal lustre suspended from the roof, and looking like a nest of diamonds. In the Entertainment Court and Concert Room together there are nearly 500 lights, and the stalls in the wide avenue leading to the railway station, have yet to be lighted. In all there will be about 700 lamps required when the exhibit is complete. To drive the 500 lamps now going there are eight

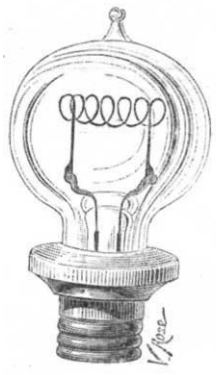

FIG. 4.

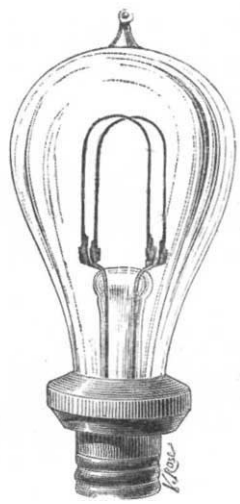

FIG. 5.

dynamo-electric machines at work, and four more are being got ready for the remaining 200 lights. Three Robey engines of 25 horse-power nominal are planted to work these machines, one engine to every four machines. It is usual to allow ten lamps to each horse-power, but what the actual power consumed may be is difficult to state.

The lamp itself consists of a strong bulb of glass about the shape and size of a large Jargonelle pear, say 4½ inches long by 2½ inches in diameter at the thickest part. From the narrow end a tube of glass projects nearly half-way into the bulb, and contains [the ends of the copper

conducting wires or electrodes. The inner end of this tube is closed by a flat keel of solid glass, but the wires pass through this into the upper part of the bulb, where they are connected by an electrotype of copper to a fine loop or arch of carbonised woody fibre cut from the silicious skin of the bamboo cane. Mr. Edison exhibits specimens of bamboo from China, Japan, and South America, as well as fibres from Brazil, which he has tested in seeking a good and durable carbon for his lamp. He shows also a number of samples of the carbonised loops made by simple charring in a crucible or by treatment after the Berthollet process, as well as loops of pure graphite very carefully cut. What the particular bamboo is that he has finally adopted we have never been able to learn, but it is probably a variety of the "Shikakuahikee" of Japan, which yield a very close and even skin. The carbon loop is about $2\frac{1}{2}$ inches high, and 1 inch wide, and is so fine that its electric resistance is about 100 ohms. in the "16-candle lamps," and about 50 ohms. in the 8-candle lamps. All the lamps at the Crystal Palace are plain single loop lamps; but sometimes Mr. Edison combines two or more loops, as shown in Figs. 4 and 5. These loops can either be coupled up "in series," or "quantity," and instead of making the loops plain they may be curled into a spiral form. The air being exhausted from the bulb there is no oxidation of the carbon after a short time and Mr. Edison claims that his lamps will last 1000 hours. This at an average rate of between three and four lighting hours per night would give a life of nine months to each lamp; but the estimate may be found a little partial in practice: for though the carbon does not burn, it is doubtless slowly dissipated by the wasting action of the gases and the energy of the current. As Mr. Edison claims to make the lamps at a shilling each, their durability is not so very important as it might at first appear. The Edison dynamo electric machine consists of two vertical electromagnets inclosing between their lower pole pieces of soft iron, a revolving armature. In the armature the usual coils of insulated wire are replaced by longitudinal bars of copper of trapezoidal section insulated from each other by brown paper. These bars are connected to the slips of the commutator in such a manner as to give a continuous circuit through the bars and a continuous current to the brushes when the armature revolves. The main conductor conveying the current from the machine consists of a solid rod of copper in

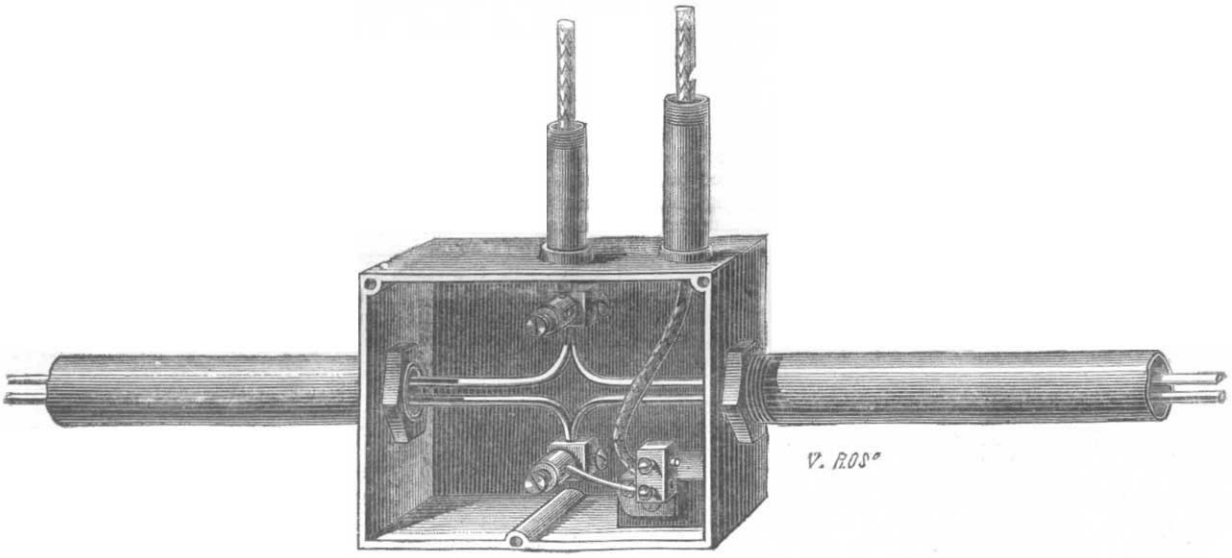

FIG. 6.

cross-section, like a segment of a circle. Two of these rods, the outgoing and return wire, are inclosed a little apart in the same iron pipe and insulated by a black compound resembling Thomson's wax. Branch-conductors in the form of cables for side-streets are connected to the mains in a joint-box shown in Fig. 6. This consists of an iron box in which the mains are connected to two iron terminals. One branch cable is connected to one of these terminals direct, and the other through a short piece of lead to the other terminal. The lead acts as a safety-valve in fusing if the current is too powerful. The box is hermetically sealed, to keep the inside dry. The conductors led into the houses are of a still smaller size, having a diameter of from two to three millimetres; but throughout the whole system the going and returning wires keep together, and the lamps are simply connected across between them. In each lamp, too, there is a similar safety connection of lead to protect the carbon if the current is too strong.

The incandescent system has evidently been brought to great perfection by Mr. Edison, backed as he is by plenty of capital and skilled assistance. Although the idea of it is not new, and was patented in England by Mr. Starr in 1845, Mr. Edison deserves great credit for working it out in so practical a form. Starr described a vacuous bulb of glass containing a thin rod of carbon rendered incandescent by the passage of the current, and Mr. Edison found in this the rough pebble which he has cut and polished with so much success. Moreover, he saw the merits of the incandescent system for domestic lighting at a time when other electricians were giving all their attention to the arc light; and therein showed his genius and foresight. For it is evident now to electricians that while the arc light is well enough adapted for the lighting of large areas, it is unsuitable for small interiors. The practical success of Mr. Edison's system is not thus far a complete justification of his early promises, for the cost is still an unknown quantity, as far as the public are concerned, and there are strong reasons for believing that it will not nearly be so low as the startling figure held out in 1878.

NOTES

AT the annual meeting of the Geological Society the medals were presented as follows:—The Wollaston Gold Medal to Dr. Franz Ritter von Hauer, Director of the Austrian Geological Survey; the Murchison Medal to Prof. Jules Gosselet, of Lille;